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# SCIENCE

FRIDAY, JUNE 18, 1915

BEFORE AND AFTER LISTER

LECTURE II., AFTER LISTER

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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

YESTERDAY the dominant note was one of despair and defeat. To-day the dominant note shall be one of joy and victory.

Instead of hospitals reeking with pus and emptied by death, of operation after operation, when the roll was called, reporting a mortality of 40 per cent., 50, 75, 90, and even 100 per cent.—we have hospitals of immaculate whiteness and emptied by quick recovery, while the roll-call of operations reveals very few mortalities exceeding 10 per cent.; most of them having fallen to 5 per cent., 2 per cent., 1 per cent., and even small fractions of 1 per cent.

The story of Lister's work as recorded in his successive papers<sup>1</sup> is one of the most fascinating in all surgery. His earliest studies, from 1853 to 1863, were in physiology and pathology. Next he took up his researches on putrefaction (or as we should now say infection and suppuration) which led to his devising the antiseptic system. He was influenced to make these observations and experiments, which he applied with such signal success to surgical problems, by Pasteur's earlier researches. He always cheerfully acknowledged his debt to the eminent Frenchman. When a student in Paris in 1865 I knew Pouchet fils and was an interested spectator in the fight between Pasteur and Pouchet's father as to spontaneous generation. Lemaire's book on "Acide Phénique" (carbolic acid) was published in that same year.

Bacteriology did not exist as a science, but Pasteur, Lister and a few of the elect

<sup>1</sup> Lister's Collected Papers, 2 vols., Oxford, 1909.

in the upper realms of imagination saw the "germs" or "microbes" and firmly believed them to be the cause of infection. In 1900, at the age of seventy-three, Lister restated his earlier work<sup>2</sup> and illuminated it by many observations, experiments and drawings made in these early years, but first published fifty years after they were made.

If you wish to know the man, his fertility in devising new and convincing experiments, and his mental acumen in interpreting them "read, mark, learn and inwardly digest" that paper and use it as a model.

Paré in his naïve way tells us that he sought various applications which might "mitigate the pains [of his patients] and happily"—mark the word "*happily*"—"bring them to suppuration." That is the "laudable pus" of the pre-Listerian days. Lister, on the contrary, believing that infection and suppuration were evils, and avoidable evils, sought by various means to prevent them. But he says "all my efforts [during his work in Glasgow, 1860-69] proved abortive," and then adds significantly "as I could hardly wonder when I believed with chemists generally that putrefaction was caused by the oxygen of the air."

They and he were deeply impressed with the absence of putrefaction in simple fractures when the air and its oxygen had no access to the fracture. In my own lectures, as I often used to express it, "The very best antiseptic dressing is an unbroken skin." In compound fractures on the other hand when the air and its oxygen *had* access to the lesion, putrefaction always took place and caused a frightful mortality.

To test this supposed noxious influence of oxygen he devised many experiments, and among them one which may be well called

an "experimentum crucis." He filled four flasks one third full of urine (a quickly putrescible liquid) and drew out the necks to tubes one twelfth of an inch in diameter. All these tubes were *left open*. Three of these long necks he bent at various angles downwards; the fourth was left vertical upwards and also open. He then boiled all four flasks and awaited the result. The air and its oxygen had free access to the urine, being slowly drawn in during the colder night hours and driven out in the warmer daytime. Any supposed "germs" floating in the air, he reasoned, being heavier than air, could not climb up the slanting necks and fall into the liquid. In a short time the urine in the flask with the vertical open neck was decomposed, but the other three flasks, also with open necks but bent downward, *remained undecomposed for four years!*<sup>3</sup>

Could there be a more convincing proof that the oxygen had no influence whatever in producing putrefaction, but that it was due to living matter, "germs," in the air? It was a fine instance of the "scientific use of the imagination." "Germs" had been observed from time to time, but had not been generally accepted as the *vera causa* of putrefaction. The experiment just related was tried about 1867. The commonest, all-pervading germs, the staphylococcus and streptococcus, were not identified and proved to be the chief pyogenic (pus-producing) organisms until 1881, fourteen years after Lister had seen them so clearly with his mind's eye! Even in 1898 when I published my "Surgical Complications and Sequels of Typhoid Fever" I had to prove by elaborate citations of experimental and clinical evidence that the typhoid bacillus itself could cause suppuration, and that it

<sup>3</sup> For a fuller account of this interesting experiment with references see my "Animal Experimentation and Medical Progress," pp. 204-205.

<sup>2</sup> *Brit. Med. Jour.*, 1900, II., 969.

had actually been observed in the circulating blood—for the past ten years or more a work of supererogation.

From Glasgow Lister went to Edinburgh (1869) as the successor of his father-in-law, Syme, and continued to experiment, to practise and to publish, but only a few were convinced, among them being Syme himself.

On the continent in the early 70's Saxtorph in Copenhagen, Thiersch in Leipzig, Volkmann in Halle, Nussbaum in Munich, and Championnière in Paris were among Lister's earliest and enthusiastic disciples: In America not much attention was paid to his work until he visited Philadelphia in September, 1876, to attend the International Medical Congress held in connection with the Centennial Exhibition. He was made president of the Section on Surgery and read a paper on the antiseptic method.

At that time I heard him and became fully convinced of the truth of the "germ theory" and of the value of his antiseptic method. When I went on duty at St. Mary's Hospital, October 1, 1876, I adopted the system (and was the first surgeon in Philadelphia to do so) and have never abandoned it. For me it changed surgery from Purgatory to Paradise.

But the reception given to his paper at our congress was anything but enthusiastic. The only surgeon who practically accepted Lister's method was that excellent St. Louis surgeon, John T. Hodgen. But so hazy were the general ideas of bacteria that in his own paper Hodgen speaks only of "germs" and "germinal matter" and had no idea of bacteriology as we now know it, for the science, and even its name, did not yet exist.

In the discussion of Hodgen's paper Hewson advocated his then well-known views on the value of dry earth as an "antiseptic." Canniff of Toronto rejected *in*

*toto* the germ theory of putrefaction. Frank Hamilton, of New York, while claiming extraordinarily good results from the open-air treatment and the warm-water treatment and other rival methods, "damned with faint praise" the antiseptic method. Kinloch, of Charleston, took the same attitude; Carpenter, of Pottsville, a Civil War surgeon, advocated chlorine in septic cases. Others sang pæans in praise of "perfect cleanliness" and said they "used both carbolic and salicylic acids, but *not* for the purpose of excluding germs." In the discussion on Lister's paper, Van Buren, of New York, doubted the safety of the spray in hernia and abdominal sections and Satterthwaite, of New York, rejected the germ theory of putrefaction.

In 1877 Girard, of the U. S. Army,<sup>4</sup> became the enthusiastic supporter of Listerism.

In 1880 Markoe, of New York, while admitting the fine results of Listerism, spoke of "its somewhat arrogant pretension to be the true and only gospel of the surgery of wounds."<sup>5</sup>

In 1882 Listerism was again discussed in the American Surgical Association. Briggs, of Nashville, endorsed Lister's method as "an epoch in surgery." Yet so limited was our knowledge of "germs" even then that warfare was waged only upon those "in the air." When these could be excluded he said "putrefaction . . . fails to occur." Yet Briggs qualifies his endorsement by saying that the

supremacy [of the antiseptic method as contrasted with other methods of treatment] . . . can not be demonstrated by statistics . . . and the present unsettled opinion concerning the proper status of his [Lister's] method is due in great measure to that fact.

<sup>4</sup> Circular No. 3, Surgeon General's Office, August 20, 1877.

<sup>5</sup> *Amer. Jour. Med. Sci.*, LXXIX., 1880, p. 305.

He emphatically dissented from the germ theory, and added

Carbolic acid is the keystone of the Listerian wound treatment. . . . The germ theory is at fault and furnishes a very unstable foundation for a system of wound treatment.

Moore, of Rochester, N. Y., proposed to exclude the air

by passing carbonic acid gas directly into the place where the operation is to be performed. In consequence of its being heavier than the atmosphere it preoccupies the space (!).

Campbell, of Georgia, "did not believe that bacteria . . . are the cause of that condition [suppuration]." The various men named were among our foremost American surgeons.

Lister's opponents entirely missed the great fundamental facts underlying the germ theory and Lister's antiseptic method, viz., that infection in all its various forms was always of bacterial origin—a wholly novel and momentous idea. Each form of infection, *e. g.*, tetanus, tuberculosis, typhoid, etc., it was soon proved, arose invariably and solely from its own specific kind of germ. Whether carbolic acid or any other germicide was the best was a mere matter of detail and not of principle.

In commenting on this discussion in which one prominent speaker is said to have asserted that Listerism "is now dead"—a remark I do not find in the *Transactions*—*The Lancet*,<sup>6</sup> a belated, but then, and ever since, a real convert, truly said

Surely it is too late in the day to contest the truth of the germ theory.

Yet even a year later (1883) at the American Surgical Association while B. A. Watson, of Jersey City, fully accepted Listerism, other prominent surgeons of Philadelphia, New York, New Orleans, Mobile, and other cities even declared in the discussion that no surgeon in their

<sup>6</sup> July 1, 1882, p. 1088.

cities or states used the method. McGraw, of Detroit; Dawson, of Cincinnati; Campbell, of Georgia; Prince, of Illinois, were "doubting Thomases," while Kinloch, of Charleston, and Nancrede, then of Philadelphia, advocated it.

But if its progress was obstructed in the United States, its foes in Great Britain were even more strenuous and for a season more successful.

In spite of the striking results in Glasgow and in Edinburgh Lister was looked at askance as "unorthodox."

In 1875 *The Lancet*<sup>7</sup> had said

there is less antiseptic surgery practised in the metropolitan hospitals than ever there was.

At the Clinical Society<sup>8</sup> in a debate on antiseptic surgery in 1875, Mr. Maunder said with a fine, but, as the event showed, a too precipitate sarcasm:

Mr. Lister expects to prevent traumatic fever and . . . suppuration.

Timothy Holmes, while professing to have used antiseptics "for some years," declared his disbelief in Mr. Lister's theory with regard to "germs." *The Lancet's* editorial on the debate said it was "evident that few of the speakers either place faith in Lister's theory or carry out his practise in full."

After eight years in Edinburgh Lister was chosen professor of surgery in King's College, London, in 1877. This was the last stand of his opponents. The *British Medical Journal*, however, heartily urged the appointment of "the great surgeon of Edinburgh."

October 1, Lister gave his first lecture. He took as his subject "Bacteriology," though not using that title for, as Stewart said, "as yet the science had not a name."<sup>9</sup>

<sup>7</sup> October 16, 1875, p. 565.

<sup>8</sup> *Lancet*, October 30, 1875, p. 628.

<sup>9</sup> The earliest instance of the use of the word "bacteriology" I have found is a quotation dated 1884 in the Oxford Dictionary.

Stewart<sup>10</sup> gives a vivid account of the dreary days during which he and the other assistants whom Lister had brought with him from Edinburgh wandered in the wards of other hospitals "heavy with the odor of suppuration" while Lister's own small wards were filled with empty beds. Instead of the Edinburgh crowds of "500 eager listeners" their "hearts were chilled by the listless air of the 12 or 20 students who lounged into lecture at King's"—only 12 or 20 students!

But a month later the tide turned.<sup>11</sup> A case of fractured patella was admitted and in violation of all surgical precedent, for in that septic era to open a knee-joint meant too often the loss of limb or even of life, Lister boldly opened the joint, but with every antiseptic precaution, and wired the two fragments together. This elicited the remark from a distinguished London surgeon:

When this poor fellow dies, some one ought to proceed against that man for mal-practise.

But the man *got well*. Soon after this a case with an enormous malignant tumor of the thigh, which had been declined by other surgeons, came to Lister. He amputated the limb and,

the members of the staff and students visiting this interesting patient were astonished to find him in a day or two sitting up in bed and reading a paper, being free from pain and free from fever.

A little later Paget and Hewitt both refused to operate on a lady of social importance with a large tumor of the shoulder-blade. Lister operated in the presence of Paget and Hewitt and she recovered without suppuration, fever or pain.

Yet two years later still (1879) Savory, Thomas Bryant, Tait and Spence, while claiming to practise antiseptic surgery so far as strict cleanliness was concerned, de-

clined to subscribe to Lister's doctrines or to practise his method.

But the enthusiastic acclaim of the International Medical Congress in Amsterdam in that same year set the seal of approval of the profession at large. This may be said to be the date of the general acceptance of Lister's theory and Lister's method. London then capitulated.

In 1902, twenty-three years later, London made ample amends for its persistent early skepticism by a most generous outburst. The Royal Society, of which Lister had been president and from which he had received two medals, gave a banquet in honor of the jubilee of his doctorate. It was a most distinguished occasion and was made preeminent by a happy sentiment by Mr. Bayard the American Ambassador. Said he, addressing Lister:

My Lord, it is not a Profession, it is not a Nation, it is Humanity itself which, with uncovered head, salutes you.

Better, far better, such a eulogium than the peerage which had been already bestowed upon him.

Having now traced so imperfectly the fortunes of the germ theory, let us see the results of Lister's labors. The first results are his own, especially in Glasgow. There the horrible conditions he has so startlingly portrayed<sup>12</sup> should have made his wards a charnal house.

The mortality in the other accident ward was so excessive that it had to be closed. But in Lister's ward, separated from the other only by a corridor twelve feet wide, for the nine months "in which his antiseptic system had been fairly in operation . . . not a single case of pyemia, erysipelas or hospital gangrene had occurred."

The reason for his first attempt to apply

<sup>10</sup> *Wrench*, p. 274 *et seq.*

<sup>11</sup> *Wrench*, p. 278 *et seq.*

<sup>12</sup> *Lancet*, 1870, I., pp. 4, 40, and quoted in my "Animal Experimentation and Medical Progress," pp. 216-18.

the antiseptic system to man is well stated in his very first paper on the antiseptic method in 1867.<sup>13</sup> He wrote

The frequency of disastrous consequences in compound fracture, contrasted with the complete immunity from danger to life or limb in simple fracture, is one of the most striking as well as melancholy facts in surgical practise.

Well might he say this, for while simple fractures had practically no mortality, the mortality of compound fractures was all the way from 28 to 68 per cent.! In this, his first paper, he reported in detail eleven cases, with one death, an unheard of mortality of only 9 per cent.!

Thus encouraged, he attacked with an equally happy outcome abscesses, especially that bane of surgery in those septic days, abscesses of the spine. Be it observed too that fifteen long years were to elapse before the tubercle bacillus, the cause of such abscesses, was discovered by Koch (1882).

From accidental wounds it was but a step to deliberately inflicted wounds, *i. e.*, surgical operations. Here too preventive antiseptics gave equally valuable results.

Lister, however, was much more given to establishing principles and methods than to statistics, but some of his early disciples published striking proofs of the value of his method by contrasting their former results with those which followed the acceptance of the germ theory and the adoption of Lister's antiseptic treatment.

Thus Dennis<sup>14</sup> (1890) says that

The time is within my own recollection when, in Bellevue Hospital, amputation was immediately performed as a routine treatment to prevent blood poisoning, upon the admittance of a compound fracture; and this operation was considered by surgeons as offering to the patient the only chance of recovery.

This but corroborates what Syme had

<sup>13</sup> *Lancet*, 1867, I., p. 326 *et seq.* and II., p. 95, and Lister's "Collected Papers," II., p. 1.

<sup>14</sup> *Medical News*, April 19, 1890, p. 423.

already said in Edinburgh, that on the whole he was inclined to think

it would be better if in every case of compound fracture of the leg amputation were done without any attempt to save the limb.<sup>15</sup>

Dennis in his paper reported 681 cases of compound fracture, with only 19 deaths, a mortality of only 2.8 per cent., and only one of these 19 deaths was from sepsis, or 1/7 of 1 per cent.!

In Nussbaum's insanitary hospital in Munich, which Lister visited in the summer or autumn of 1875, he states<sup>16</sup> that pyemia had been

very frequent and hospital gangrene which made its appearance in 1872, had become annually a more and more frightful scourge until in 1874 it had reached the astounding proportion of 80 per cent. of all wounds that occurred in the hospital, whether accidental or inflicted by the surgeon!

After trying every possible different method of treatment and still being unable to combat hospital gangrene and pyemia, Nussbaum finally adopted Lister's full antiseptic treatment and from the beginning of 1875 they had "not had one single case of hospital gangrene . . . and were doubtful whether they had had one case of pyemia"; and

the convalescent wards—which previously had been filled and overflowing constantly—Lister saw standing one after another empty, because patients, no longer affected with hospital gangrene, recovered much more rapidly.

In Halle Volkmann<sup>17</sup> was operating in an extremely unhealthy hospital in small, overcrowded wards, with the toilet rooms opening directly into them and a large drain running directly underneath. It was so

<sup>15</sup> Cameron, *Brit. Med. Jour.*, December 13, 1902, pp. 1844-45.

<sup>16</sup> *Brit. Med. Jour.*, 1875, II., p. 769, and "Lister's Works," Vol. II., p. 248.

<sup>17</sup> "Lister's Works," II., pp. 249-51, *Brit. Med. Jour.*, 1875, II., p. 769, and Lindpainter (Volkmann's assistant), *Deutsch Zeit. f. Chir.*, October, 1876, p. 187.

bad that it had been condemned to demolition. In the two years after his introduction of the antiseptic method in 1872, no single patient suffering from compound fracture had died either from the fracture or from a necessary amputation, nor was there a single death from secondary hemorrhage or gangrene. No case of blood poisoning had occurred for a year and a half, though sixty amputations had been done. Just before Lister's method had been introduced, of 17 amputations 11 had died from pyemia alone, a mortality of 65 per cent. Just after adopting Listerism the death rate of his amputations fell to 4 or 5 per cent.<sup>18</sup>

Hospital gangrene had been as it were "blown away" by a puff ("weggeblasen"); not a single case occurred. In Lindpainter's extensive tables of Nussbaum's cases one is struck, on glancing over them, to see how before the antiseptic method was adopted case after case is marked "died," "died," "died," and in the later tables, after its adoption, almost a uniform "recovered," "recovered," "recovered."

But the most striking testimony to the value of Lister's services to suffering humanity is not the statistics of the mortality in amputations, compound fractures, puerperal fever<sup>19</sup> or in any single disease or operation, but in the enormous and successful enlargement of the beneficent field of surgery. In my own early days "before Lister" the common operations were

1. Amputations.
2. Ligation of arteries.
3. Removal of external tumors.
4. Lithotomy.
5. Tracheotomy, chiefly for croup and foreign bodies.

A few resections, colostomies, trephining

<sup>18</sup> *Lancet*, 1881, II., p. 281.

<sup>19</sup> See the extraordinarily interesting paper by J. Whitridge Williams, *Jour. Am. Med. Ass.*, April 22, 1911.

(when unavoidable) and herniotomies (for strangulation) were done. Ovariectomy was never done until the tumor had become so large as to threaten life, and even then operation was denounced by many as wholly unjustifiable, for it had a mortality as high as two out of every three cases. The head, the chest, the abdomen were ticketed "*Noli me tangere*" except in the rare cases when operation was absolutely unavoidable.

I used to wonder why the students in "Rab and His Friends" rushed to the amphitheater to get the best seats to see Syme amputate a breast—a so very common operation nowadays. But then I recalled the fact that even in my student days, when anesthesia was the rule, capital operations were rare. But in the preanesthetic days operations were far rarer. In the *five years* preceding the introduction of ether at the Massachusetts General Hospital the *entire staff* only performed in all *184 operations or three operations a month*. When operations had become not only painless, but safe, then the number performed increased almost at a geometrical ratio, so that at present the numbers even of single operations by single surgeons—*e. g.*, of ovariectomies, appendectomies, goiters—mount into the thousands. What is still more gratifying, the usual death rates of most capital operations in the pre-Listerian days of one patient in four, in three, or in two, or even two out of three (!) have been changed to one in twenty, thirty, fifty, or to even less than one life lost in one hundred or even one in two hundred operations!

It is impressive—most impressive—to call the list of only the most frequent and the most important of our present operations. Were Mott, Bigelow or Pancoast—all of whom I remember well—to come to life again they would wonder whether we were not stark crazy.



The following list I have made—*currente calamo*—on the instant.

Amputations are far *less* frequent. After a single battle in the Russian campaign, Larrey, Napoleon's great surgeon, performed not less than 200 amputations. To-day of 200 similar cases, sometimes even with wounds involving joints, the great majority would recover without amputation.

Formal ligations are far fewer.

External tumors of any size are now removed from all parts of the body without fear of erysipelas, which so worried Sir Astley Cooper before he operated on the king for a simple wen. The mere fact that any tumor is internal—inside the head, the chest, the abdomen, or the pelvis—has practically no influence on the decision whether it should or should not be removed.

Trephining—even for exploration—is frequent and *per se* involves slight danger, as in decompression.

Martin, of Berlin, has done over 1,000 ovariectomies, with a mortality of less than 2 per cent., and the Mayos from 1905 to 1914, inclusive (the only period for which I had the annual reports at hand), reported 609 cases with 5 deaths, or eight tenths of 1 per cent. Colostomy and enterostomy are frequent. Many thousands of hernias have been cured by operation, with practically no mortality; and if done early in strangulation, with slight mortality.

The new surgery of the head attacks tumors even of the hypophysis, punctures the lateral and the fourth ventricles with impunity, successfully extracts foreign bodies and in some cases relieves epilepsy and mental derangements.

In the neck simple goiters even of large size are removed, with a mortality of 1 and 2 per cent.; and laryngectomy is common.

In the chest, that very citadel of life, the heart itself is sutured for gunshot and stab wounds, saving one life out of two; the

esophagus is attacked for cancer and the removal of foreign bodies; large portions of the chest wall are removed for old empyemas, and the lungs can now be operated on at leisure, thanks to insufflation anesthesia.

In the abdomen, the various operations on the stomach, even to its total extirpation, are too many to name in detail; and with a success that is truly marvellous. We play with the intestines at will, opening them for foreign bodies and for drainage of the contents, removing what we wish, anastomosing them and short circuiting their contents. Tumors of the liver unless malignant are extirpated with a very low mortality and wounds of its substance are treated with success; gall stones and gall bladders are removed every day; the spleen is anchored, sutured or removed as we find best; the pancreas is no longer inaccessible; the kidney and the ureter, like the stomach, have their own list of operations far too long to rehearse.

In the pelvis the bladder is opened and partly or even wholly extirpated; the prostate removed; the uterus, the ovary, the tubes, the parovaria have a long list of life-saving, comfort-giving operations to their credit.

We suture and anastomose nerves; we suture and anastomose blood vessels even in the new-born, we criss-cross the circulating blood to prevent gangrene, and endo-aneurismorrhaphy has practically banished the Hunterian operation for aneurism and saved many a limb and life. We transplant skin and bones and joints, and even half joints, with success. To all these we have added the X-rays, the serum and vaccine treatment of many surgical disorders and are gradually throttling disease, sometimes at its very birth.

It almost takes one's breath away! Yet

it is an incomplete and ever-lengthening list! As Mumford<sup>20</sup> well says:

Daring has become conservatism; rashness has become common sense.

*Practically our ability to do all these life-saving operations is the result of the researches, the experiments, and the achievements of Lister and his followers. Had antiseptics not made all operations, including the opening of the head, the chest, the abdomen, and the pelvis, safe, we should still be practising the very limited surgery of the 60's. Every year thousands whom now we restore to life and health would still be dying.*

What now are the prospects of Listerism in the present horrible war? I have so far used the term "antiseptics." Asepsis is a later and a natural development of antiseptics and in civil life is of course preferable. The underlying and enduring principle of Listerism—the germ theory—is the same in both. There is no fundamental antagonism, but really a fundamental agreement between the two methods.

In the present war the surgeons whose papers I have so far read are almost a unit in favor of the antiseptic rather than the aseptic treatment of the wounded. They are right in my opinion, and the reason is plain. Comparatively few of the wounded reach hospitals with uninfected wounds. Mild wounds, and even in some cases severe ones, if they can be dressed soon after being inflicted, heal readily.

Sir Anthony Bowlby's<sup>21</sup> striking description of the conditions in the trenches shows the difficulties very clearly:

In this trench warfare, if a man is hit, he often falls into filthy mud and water, which may be three feet deep or more. The trench is only two and a half feet wide. It is night, you can only grope about in the dark and can do no dressing of any kind, for you can't even get any clothes off in the dark, and in so cramped a space, and you

must try to get the man away to a "dressing station" half a mile distant, and thence to a field ambulance. If it is daylight, you can't get the man out of the trench at all, and he may have to be kept there for many hours, because he would certainly be killed if he were got out of the trench. And the water in the trenches is hopelessly polluted and soaks his clothes and his wound. Large lacerated wounds, and especially bad bone smashes, are so contaminated that it can never be possible to render them aseptic.

There is a noteworthy difference between the results of the wounds in the case of the trench-inhabiting soldiers and the wounds of sailors. The latter escape the dangers of the soil-infected trenches.

Sailors with the most severe type of wound, ragged, irregular, with uneven surface produced by herniated muscle and retracted severed fibers, usually have recovered promptly. Soldiers suffering from slight wounds have often had them contaminated with bacilli from the soil; particularly the anaerobes.

Hypertonic salt solutions like sea water are actually remedial by promoting the flow of lymph and serum in the wounded tissues.

But in a very large number of wounded soldiers, possibly the majority, hours and sometimes even days of delay ensure infection and then the surgeon is face to face with the one overwhelming surgical problem which has so far baffled all our efforts, viz., *how to transform a septic wound into an aseptic wound and keep it so, and at the same time how to combat the toxins already diffused throughout the body, but without doing harm to the patient himself.* Cheyne,<sup>22</sup> Ehrlich, Wright and Carrel are all at work and it may be that the happy day when this, the most pressing and urgent problem in surgery, shall be solved, may come through this devastating war.<sup>23</sup>

<sup>22</sup> *Lancet*, February 27, 1915, p. 419.

<sup>23</sup> In the *British Medical Journal* of April 10, 1915, a most important article by Sir Almuth E. Wright on "Wound Infections" is begun. This should be very carefully read. On pp. 735-38 of

<sup>20</sup> Keen's "Surgery," I., p. 76.

<sup>21</sup> *Jour. Am. Med. Ass.*, April 10, 1915, p. 1257.

Meantime Souttar<sup>24</sup> extols plenty of fresh air or better still of oxygen (our old supposed enemies in the 60's) and says

Men with wounds so foul that their presence in the wards could not be permitted, were placed, suitably protected, in the open air, the wounds being left exposed to the winds of heaven, covered only with a thin piece of gauze. The results were almost magical, for in two or three days the wounds lost their odor and began to look clean, while the patient lost all signs of the poisoning which had been so marked before.

Of tetanus in our Civil War there were in the Union army in all 505 cases and 451 deaths, 89.3 per cent. In the War of 1870-1 in the German army there were 294 cases and 268 deaths, or 91.1 per cent. In the present war there have been many cases in the allied armies in the west, but I have seen no numbers or percentages. In the German army, however, Czerny<sup>25</sup> says that

the greatest danger to the wounded had been tetanus. Of 60,000 wounded Bavarians, 420 developed tetanus, which proved fatal in 240 cases (57.1 per cent.). The prophylactic value of the tetanus serum had been established, but its extensive employment was not always feasible.

This is a far larger percentage of cases than in our Civil War, or the Franco-Prussian War, but the mortality is far less—probably due to the even partial employment of the serum.

During the Civil War I never saw a case of "gas gangrene" which has been so prevalent and dangerous in the present war. The soil of Belgium and France, which has been cultivated and roamed over by animals for more than twenty centuries, is highly infected. Over ten different gas-producing bacteria have been found.

the same *Journal* for April 24, 1915, is another very important paper giving full directions for treatment. See also an interesting editorial in the *Journal American Medical Association*, May 23, 1915, p. 1765.

<sup>24</sup> *Brit. Med. Jour.*, March 20, 1915, p. 504.

<sup>25</sup> *Brit. Med. Jour.*, March 20, 1915, p. 521.

Sidney Rowland's experiment<sup>26</sup> well shows the virulent infection of the soil. Shaking up some of the soil from the trenches with some water, he injected a few drops into a guinea-pig and it was dead in eighteen hours with widely diffused gas gangrene. Soldiers have died from the disease in thirty-six hours.

Delorme has advised, as the germ is anaërobic, the injection of peroxide of hydrogen. Hartmann believes it needful to open the wounds freely and employ thorough irrigation with the peroxide<sup>27</sup>—a most important procedure. *Early* treatment of infected wounds even in cases of gas gangrene resulted favorably in the hands of Cazin. Of 158 cases received even up to forty-eight hours after battle all recovered in spite of their serious nature. Among those received after four or five days' transportation the mortality reached 10 and even 20 per cent.<sup>28</sup>

I have related the terrible mortality from typhoid in the Boer and the Spanish-American wars. The one bright spot in the present war is the conquest of typhoid. In spite of greatly increased numbers and of most unfavorable sanitary conditions in the trenches as I have shown, conditions which in former wars would have given rise to dreadful epidemics of typhoid, the following statistics in the British army officially given to Parliament on March 4, 1915,<sup>29</sup> show emphatically how well this scourge of every past campaign has been conquered. There had been only 606 cases in all: 247 among the partially (136) and fully (111) inoculated, with two deaths (0.81 per cent.), and 359 among the unprotected, with 48 deaths (7.47 per cent.), over nine times as many deaths proportionately! The one

<sup>26</sup> *Brit. Med. Jour.*, November 28, 1914, p. 913.

<sup>27</sup> *Jour. Am. Med. Ass.*, January 16, 1915, p. 259. See also Lawson and Whitehouse, *Brit. Jour. Surg.*, January 9, 1915, p. 444.

<sup>28</sup> *Jour. Am. Med. Ass.*, January 16, 1915, p. 259.

<sup>29</sup> *Brit. Med. Jour.*, March 13, 1915, p. 485.

reason for this splendid showing is the use of the antityphoid inoculation. If instead of its being only voluntary in the British army it had been compulsory as in our own army, the results would have been even better. And yet a blatant band of men and women both in England and our own country are doing all they can to oppose the use of this life-preserving remedy!

Let us now in conclusion take a general review of the surgical progress I have so inadequately sketched.

During the horrible days of Paré, Bell, Simpson, and our own Civil War there was still gradual improvement, but no *fundamental* change occurred for three centuries after Paré introduced the ligature and banished the boiling oil.

But about the middle of the nineteenth century, and especially in its last quarter, experimental research took the field. Everything that could be put to the test of accurate experiment in medicine and surgery was thoroughly investigated physically, physiologically, chemically, microscopically, biologically, bacteriologically. Laboratories were founded and research workers vied with each other in countless investigations. A flood of light was thrown upon every problem. And see the result in the long list I have just read to you! Medicine proper, obstetrics, all the specialties, sanitation and hygiene, furnish equally impressive calendars of progress—principally the result of experimental research.

Chief among these experimental researches were those of Pasteur (of whom I have said far too little for want of time) and of Lister. They inaugurated a wholly *new era* in surgery.

Then followed the battle for the germ theory and antiseptic surgery, ending in final victory. Meantime a new science, bacteriology, was born.

Next came the wide extension and appli-

cation of the new surgery to almost all the surgical ills that flesh is heir to. The wonderful results to both life and limb that I have recounted have naturally followed.

Even amid the disabilities and obstacles of war itself Lister's work has been a boon beyond price.

While the soldier and the scientist have been busy devising ever more frightful engines of destruction to maim and to kill, we surgeons have been equally busy devising means for saving thousands of lives and limbs in civil life, and even amid the carnage and savagery of war.

Surely our hearts should be lifted in gratitude to God for giving us such splendid powers of reasoning, experiment and research—all for the service of our fellow men.

W. W. KEEN

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THE TWENTIETH ANNIVERSARY OF THE  
NEW YORK BOTANICAL GARDEN

THE twentieth anniversary of the appropriation by the City of New York of 250 acres of land in Bronx Park for the use of the New York Botanical Garden will be commemorated at the garden during the week commencing September 6, 1915. Botanists from all parts of North America are invited to attend. The following program is planned:

*Monday, September 6*

Assemble at the Garden as convenient in the morning.

1:30: Lunch at the Garden.

2:30: Addresses of welcome and an account of the history of the Garden.

3:30–5:30: Inspection of a portion of the grounds and buildings.

5:30–7: Visit to the Zoological Park.

*Tuesday, September 7*

10:30–1: Session for the reading of papers.

1:30: Lunch at the Garden.

2:30–4: Session for the reading of papers.

4–6: Inspection of portions of the buildings and grounds.